SAMPLING SPECIAL SECTION

The TOS—a must in the analytical laboratory (industrial, commercial, academic)

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Understanding what sampling variation is, and how it is estimated, has been a "light-bulb" moment for our analysts after having been introduced to the TOS principles.[1] So often we have had a situation where analytical work and results can be verified, but our customer still insists it doesn't meet expectations. Short of driving the poor analyst crazy with re-work tasks, which usually only produces the same "incorrect result", I now have an avenue of action that allows us to guide the customer and analysts to the path on how to focus on only taking representative samples. This is decidedly more welcome than always having to hear: "Take the sample back to the lab—repeat the analysis".

Much time is spent determining the combined total uncertainty for specific analytical methods under validation, however, very little attention is given to the preceding sampling errors and the challenges heterogeneity poses to this issue. I now know that sampling errors dominate over their analytical cousins. Also, using variographic characterisation as a quality control tool for process and measurement system monitoring is a very powerful technique that could help process controllers explain the sources of real process variations that occur on their product lines instead of simply following through by blaming the analytical lab. I found that the international standard DS 3077 (2013) and in particular its use of illustrations and industrial examples captured the true complexity of the principal types of Sampling Errors and helped to conceptualise the TOS principles in a strikingly visual way, making it easier for a typical chemical analyst to relate to the scenarios involved before analysis. After all, we have to isolate the absolutely smallest aliquot for analysis—as demanded by highly sophisticated analytical instrumentation. It is, therefore, highly surprising that the one area of greatest error affecting analysts' results is the same topic largely ignored in Analytical Chemistry/Science Training programmes, again the sampling errors. This gives rise to "brilliant" analytical results, i.e. extremely precise results, but for non-representative samples for which accuracy with respect to the lot is not accounted for. In fact the accuracy of the analytical results with reference to the original lot is completely without control—and one cannot even estimate the magnitude of the sampling bias incurred (because it is inconstant, as is another insight provided by the TOS). This makes for a very unsure analytical laboratory. After this course I wonder how many questionable results have been released by laboratories all over the world over many, many decades—and the revelations brought about by the TOS are still not known!

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Reference

1. M.C. Gouws, "Testimony", in *Introduction to the Theory and Practice of Sampling*, by K.H. Esbensen. IM Publications Open, Chichester, p. 323 (2020). https://doi.org/10.1255/978-1-906715-29-8